CHBE 310
FUNDAMENTALS OF BIOMOLECULAR ENGINEERING
Spring 2018

CLASS MEETING: 310 001 09:25AM - 10:40AM TR KCK 102
310 002 10:50AM - 12:05PM TR KCK 107

INSTRUCTORS

Dr Laura Segatori
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TEACHING ASSISTANTS

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TEACHING ASSISTANTS' OFFICE HOURS

Tuesday 5.30-7.30 pm AEL B209
Wednesday 5.30-7.30pm AEL B209 *only by request*

COURSE WEBSITE
CANVAS (http://canvas.rice.edu/)

COURSE DESCRIPTION AND TOPICS

The objective of this course is to introduce the students to the current advances and potential of molecular biotechnology and biomolecular engineering. Fundamentals of molecular biology and biochemistry will be introduced and discussed from the prospective of genetic engineering, protein and metabolic engineering, and bioreactor design applications.

Biotechnology is defined as "any technological application that uses biological systems, living organisms, or derivatives thereof, to make or modify products or processes for specific use". The topics covered in this course will reflect the highly interdisciplinary nature of this field and will include:

- The central dogma of molecular biology
- Binding interactions and enzymatic conversions
- Foundations of DNA, the central dogma of molecular biology, DNA replication, transcription, translation.
- Regulation of gene expression.
- Tools of recombinant DNA Expression of proteins in prokaryotic systems. Introduction to directed mutagenesis and protein engineering techniques.
- Cellular metabolism and metabolic engineering.
- Kinetics of cell growth and bioreactor design.

OBJECTIVES

- Understand the molecular biology principles involved in the transfer of genetic information and learn how to manipulate them for research and industrial applications.
- Learn genetic and protein engineering tools to control molecular and cellular processes.
- Learn the fundamentals of enzyme kinetics and metabolic pathways for the overproduction of metabolites.
- Learn the kinetics of cell growth and product formation (unstructured non segregated models)
- Learn the principles of bioreactor design and fermentor configurations.
- Learn the unit operations of a bacterial fermentation process
- Further develop skills for technical communications in a team environment

OUTCOMES:

Students completing this course will learn to:

- Calculate kinetics parameters that describe biomolecular interactions
- Calculate kinetics parameters for the design of immobilized enzyme reactors.
- Develop models of primary metabolism to guide metabolic engineering.
- Design strategies for the isolation, detection, and amplification of DNA sequences, and for the selection of genes coding proteins with desired function.
- Apply genetic, protein, and metabolic engineering strategies for the design of biomolecular products for research and industrial applications.
- Design bioreactors for the production of cell mass and recombinant proteins.
- Write a persuasive report and give a persuasive presentation addressed to a chemical engineering audience

CLASS ATTENDANCE

It is expected that students attend all lectures and participate to class activities and discussion. Although class material will be mostly posted on the class website, attending class will be necessary for its analysis and understanding.

GRADING POLICY:

Exam 1:	15 %
Exam 2:	15 %
Quizzes:	15 %
Group project (written):	10 %
Group project (oral):	10 %
Final Exam:	20 %
Homework Assignments:	15 %
	100 %

There will be two midterm examinations (exams 1, and 2), one group project and a comprehensive final exam. You will be allowed to use a "cheat sheet" (A4 paper format, instructions will be provided in class). Detailed instructions about the material covered in each exam will be given in class.

The two midterm exams are scheduled on (1) Wednesday 02/28 at 7-9pm and (2) Wednesday 04/04 7-9pm. If you have a conflict, you need to notify the instructor *within two weeks from the beginning of the semester*. You must provide a written request for medical or family emergency excuses. There will be no make-up examinations.

The comprehensive final examination will be a 3-hour, in-class examination. The date and time will be determined by the registrar's office.

The quizzes will be held in class. Detailed instruction about the material covered in each quiz will be given in class.

There will be several homework assignments that will count 15% of the total grade. Homework must be completed and turned in **on Thursday in class** unless otherwise specified by the instructor. Late submissions with prior approval of the instructor will receive a 10% credit reduction for each day after the deadline. Homework will not be accepted after noon on Monday (for assignments due on Thursday) or after two full days beyond the posted deadline (in the event of an assignment due on a different day).

While each student must submit her/his individual solutions to the homework problems, you are encouraged to work together. As for most science and engineering fields, group study, by stimulating critical thinking, typically provides a valuable method of learning and results in a broader understanding of the subject. However, please keep in mind that academic dishonesty will not be tolerated.

Homework, quizzes and exams may be regraded if a written request with the original HW/quiz/test is presented within **one week from date they were returned**. Unclaimed homework, quizzes and exams will be stored in BRC 303.

HONOR CODE POLICY

Plagiarism is the undocumented inclusion of someone else's work within your work, and besides damaging your education, also violates Rice's Honor Code. The consequences for a Rice Honor Council violation typically range between an F in the course to a 2-semester suspension from Rice. We take plagiarism very seriously, be sure that you understand what is an appropriate level of collaboration before sharing information with a colleague. Please do not hesitate to contact the instructor for an explanation of what constitutes an Honor Code violation.

You are not allowed to give or receive help during the quizzes and exams, unless instructed otherwise by the instructor or the teaching assistants. Any suspicion of honor code violations for homework, quizzes, or exams will be reported to the Rice Honor Council. Information about the Rice Honor System can be found at http://honor.rice.edu/

PREREQUISITES

Pre-requisite or co-requisite: CHBE 310 and MATH 211 or consent of the instructor.

TEXTBOOKS

Required:

- Shuler and Kargi. *Bioprocess Engineering*. Prentice Hall.
- Class notes and material distributed during the semester (posted on *Canvas*)

Recommended:

- Okafor, *Modern and Industrial Microbiology and Biotechnology*. Science Publishers.
- Glick and Pasternak. *Molecular Biotechnology*. ASM Press.

- Watson. *Recombinant DNA*. Scientific American Books.

SPECIAL NEEDS

Any student with a documented disability seeking academic adjustments or accommodations is requested to speak with me during the first two weeks of class. All such discussions will remain as confidential as possible. Students with disabilities will need to also contact Disability Support Services in the Ley Student Center.

TENTATIVE SCHEDULE

Jan	tu	9	Introduction
Jan	th	11	cell mass balance
Jan	tu	16	Introduction to bio
Jan	th	18	Kinetics
Jan	tu	23	Molecular interactions
Jan	th	25	Molecular interactions
Jan	tu	30	Enzyme kinetics
Feb	th	1	Enzyme kinetics
Feb	tu	6	Enzyme kinetics
Feb	th	8	*spring recess*
Feb	tu	13	Transcription/translation
Feb	th	15	Transcription/translation
Feb	tu	20	Recombinant DNA
Feb	th	22	Review
Feb	tu	27	Cell Growth
Mar	th	1	Bioreactors
Mar	tu	6	Bioreactors
Mar	th	8	Bioreactors
Mar	tu	13	*spring break*
Mar	th	15	*spring break*
Mar	tu	20	Introduction to Metabolism/Metabolic Eng
Mar	th	22	Group Project Discussion Part 1
Mar	tu	27	Metabolic Engineering
Mar	th	29	Metabolic Engineering
Apr	tu	3	Review
Apr	th	5	Group Project Discussion Part 2
Apr	tu	10	Metabolic Engineering
Apr	th	12	Protein Engineering
Apr	tu	17	Group Presentations
Apr	th	19	Group Presentations